Stop Press

Five licence agreements signed as of October 2023

*Patagonia Lithium and Recharge Resources brines produce **99.9%** purity lithium carbonate using Ekosolve crystalline extraction process!*

EkoSolve™

A DIRECT LITHIUM EXTRACTION METHOD USING SOLVENT EXTRACTION FOR LI-RICH BRINES

DLE SOLVENT EXCHANGE FOR THE FUTURE

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EkoSolve Ltd
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THE EKOSOLVE DLE ADVANTAGES

- High recovery of Li from brines as Lithium Chloride
- Produces Battery Grade Lithium Carbonate
- Circumvents problems of brine contaminants such as Mg, Ca and B that can interfere with the recovery and quality of Battery Grade Lithium Carbonate
- Eliminates the need for solar evaporation

- No requirement for large water volumes
- Single continuous process
- Operates with brines as low as 37ppm Li
- Can have pH as low as 1
- Low operating costs – 98.8% of solvent and reagents recovered
- Low capital costs
- Environmentally friendly process

OTHER DLE SYSTEMS ISSUES

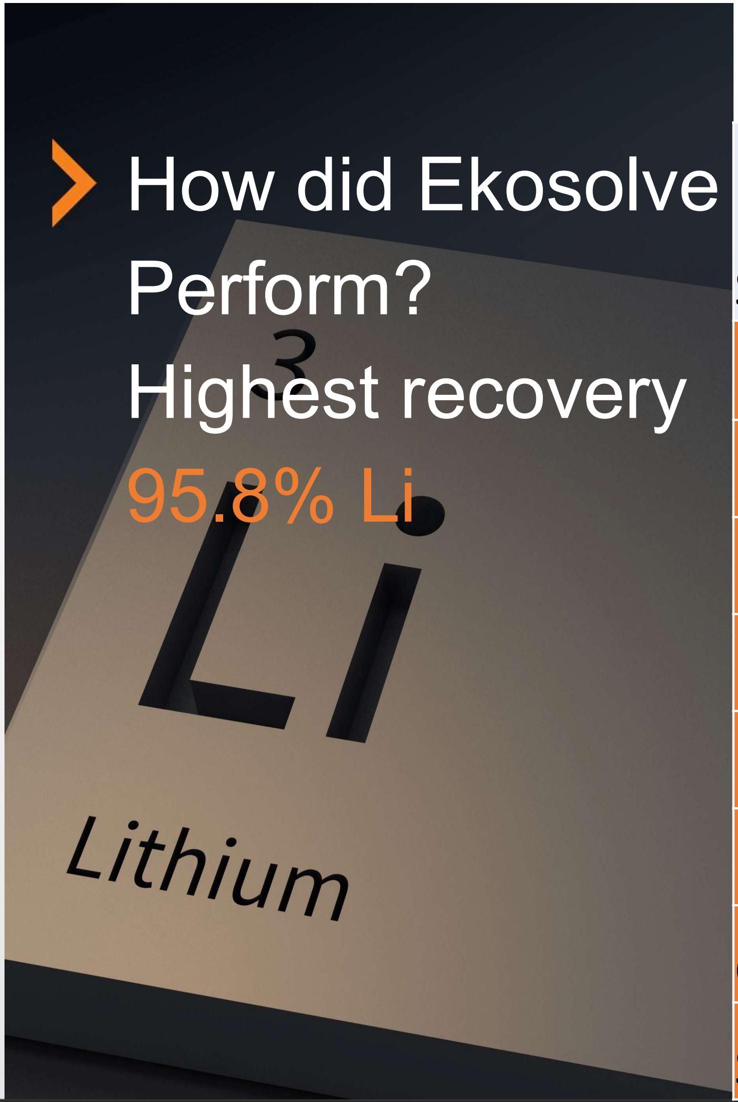
absorbents, electrochemical, nano/membrane and ion exchange technologies

- Multiple phases of treatment – not continuous
- Large amounts of water consumption
- Nano-membranes clogg-up with waste ions
- Absorption plates denigrating quickly
- Ion exchange is not selective to remove one ion type
- Electro-membrane still at concept stage and will probably need additional systems
- Most other DLE need high concentration of Lithium in brines
- Problems managing high Mg brines or oil contaminated brine or highly acidic
- Extraction system can't be regenerated

How did Ekosolve Perform?

Highest recovery

95.8% Li



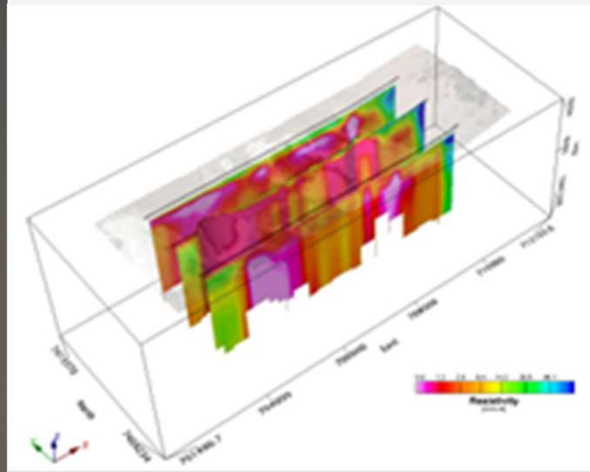
Ekosolve Pilot Plant Results To-date

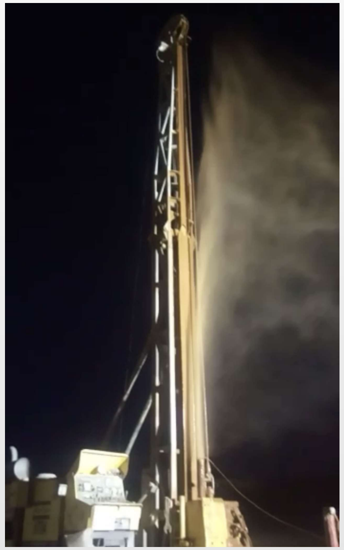
Salar/Location	Lithium content test concentration ppm	% extraction efficiency
Incahuasi	140.2	93.1
Pocitos A	86.0	94.9
Pocitos B	95.3	95.8
Rincon	195.0	92.0
Pozuelos	401.0	93.1
Formentera	266.8	92.1
Calgary Petrobrine	57.0	91.0
Stress test	37.0	91.8

THE LITHIUM MARKET IN 2024/5

Ekosolve will build a 20,000 tonne Li_2CO_3 plant in Argentina during 2024-2025 in Pocitos Salta Province

- Pocitos 1 owned by Recharge Resources (CSE:RR) has inferred a resource of 532,000 tonnes of lithium carbonate in Salta, Argentina
- Significant brine flow has been encountered
- MT survey shows low resistivity to 1000m depth
- Board has committed to build a plant by 2025





ABOUT THE EKOSOLVE DLE SOLVENT EXTRACTION PROCESS

In 2016, EkoSolve began investigating its Solvent Extraction process as an alternative to the conventional Li recovery methods.

What is *Solvent Extraction?*

Solvent Extraction, SX, also known as *liquid-liquid extraction*, is a method to separate compounds or metal complexes based on their relative solubilities in two different immiscible liquids, usually water (polar) and an organic solvent (non-polar).

The solvent that is enriched in the organic phase is the extract. The aqueous feed solution that is depleted in Li is the raffinate.

Its most significant advantage is the ability to selectively separate-out cations with very similar chemical behaviour and to obtain high-purity single metal streams from where the metal value can be 'stripped' from the 'loaded' organic phase, making it possible to precipitate the metal.

In this case, there is a net transfer of one or more species from one liquid into another liquid phase from the Li-rich brines to an organic solvent.

The transfer is driven by chemical potential, i.e. once the transfer is complete, the overall system of chemical components that make up the solutes and the solvents are in a more stable thermodynamical state; that is to say, the system has a lower free energy.

Lithium extraction

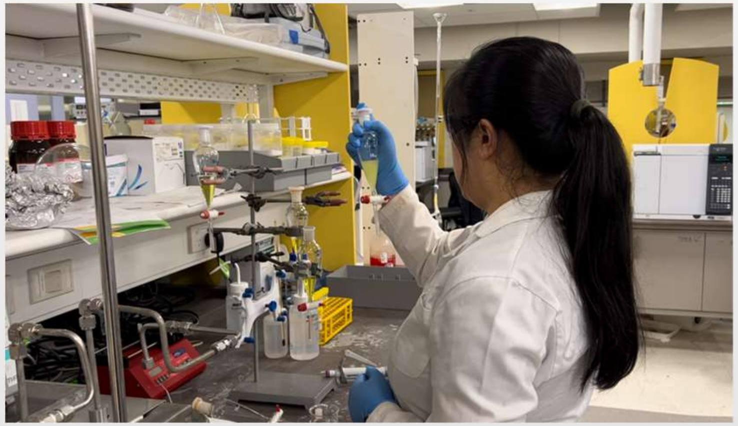
Lithium extraction has been studied extensively since the 1930s.

SX is a well-known, commonly used and well-tested commercial method for the recovery of metals.

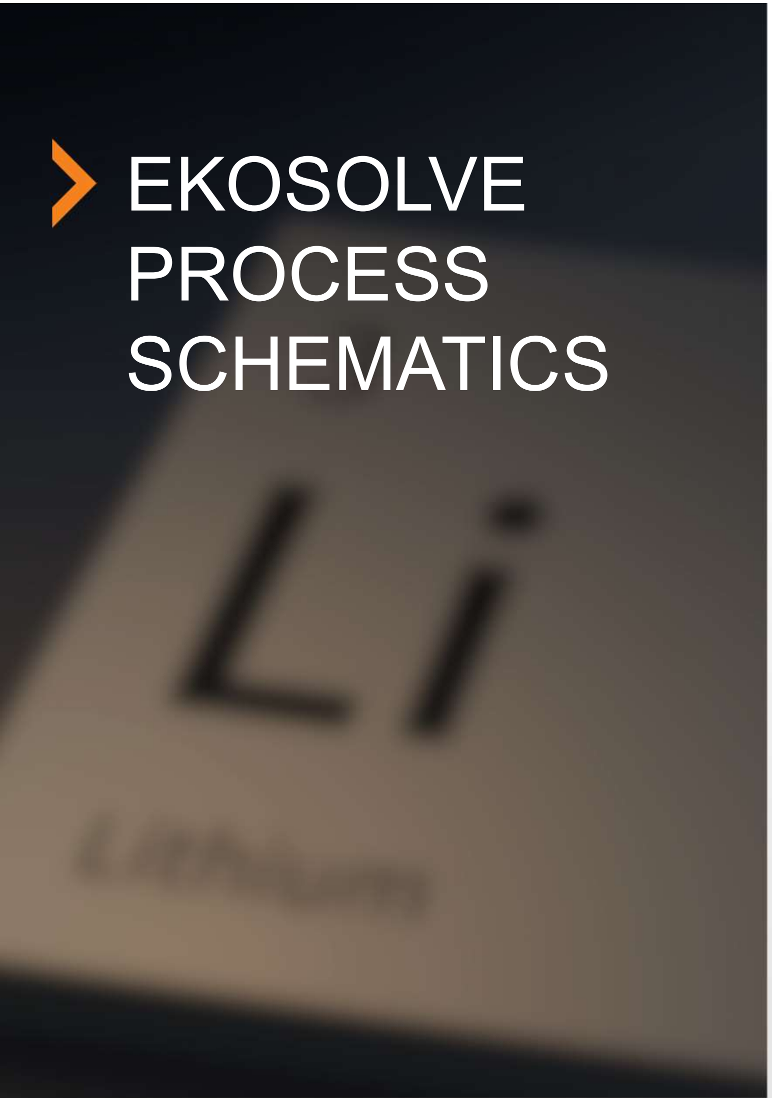
SX is the preferred method to separate and purify metals such as Co, Cu, Nd, Ni, Pt and Pd, U, Po, Zr and Hf, Zn and Cd, and for the separation and purification of Rare Earth Elements.

In 2016, EKOSOLVE LTD undertook an exhaustive review of solvent extraction, leading to an exchange of information with Tsinghua University, China.

In 2017, the Department of Chemical Engineering of the University of Melbourne was engaged to carry-out extensive bench-scale and Pilot Plant tests aimed at ascertaining the feasibility of using SX to directly extract Li from Li-rich brines obtained from Argentinean Salares, leading to the development of EkoSolve.



EKOSOLVE PROCESS SCHEMATICS



INPUT BRINE

EXTRACTION
loaded organic
with Li ions

WASHING
Washed organic

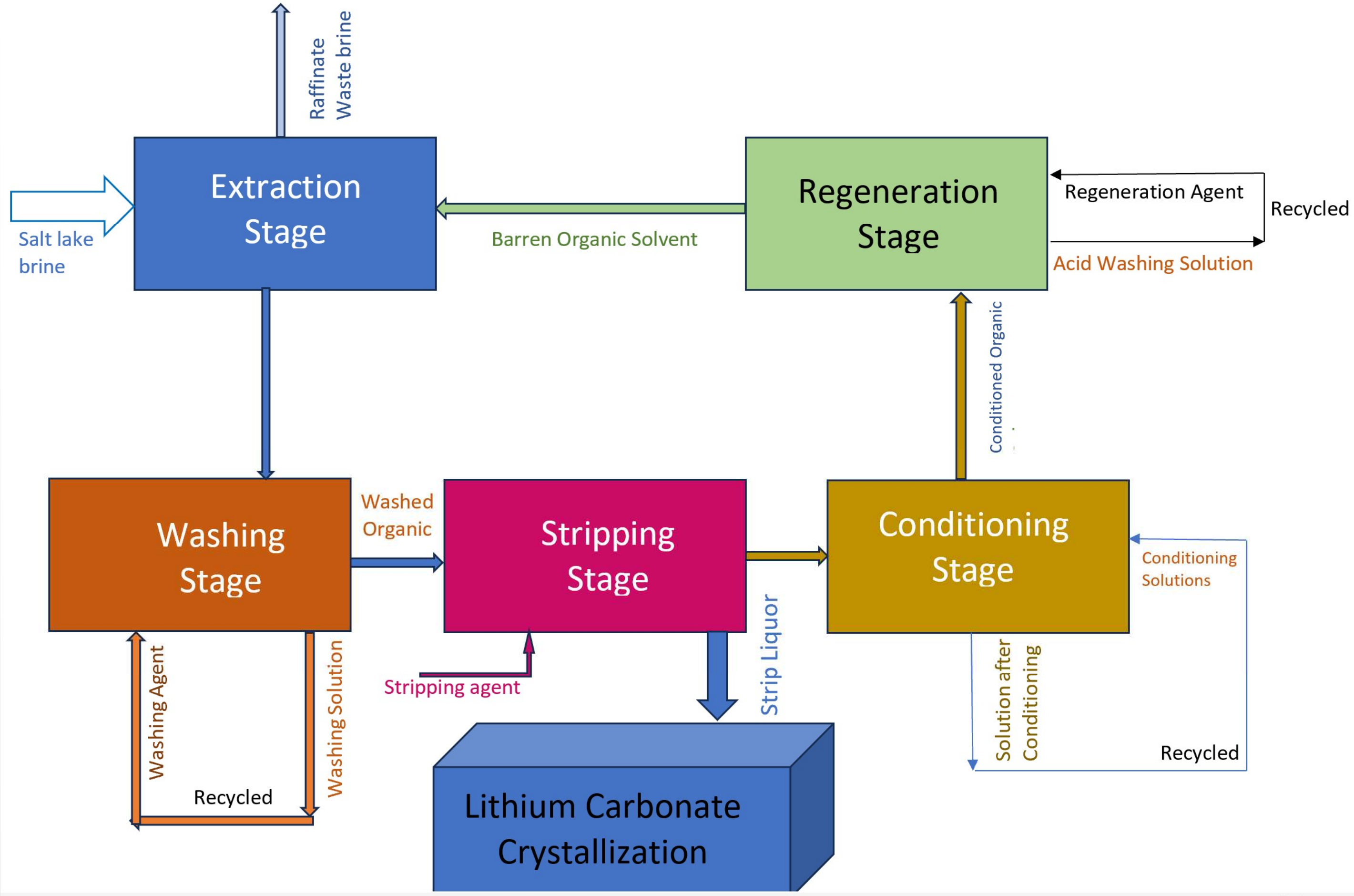
STRIPPING
stripping agent
Stripped organic

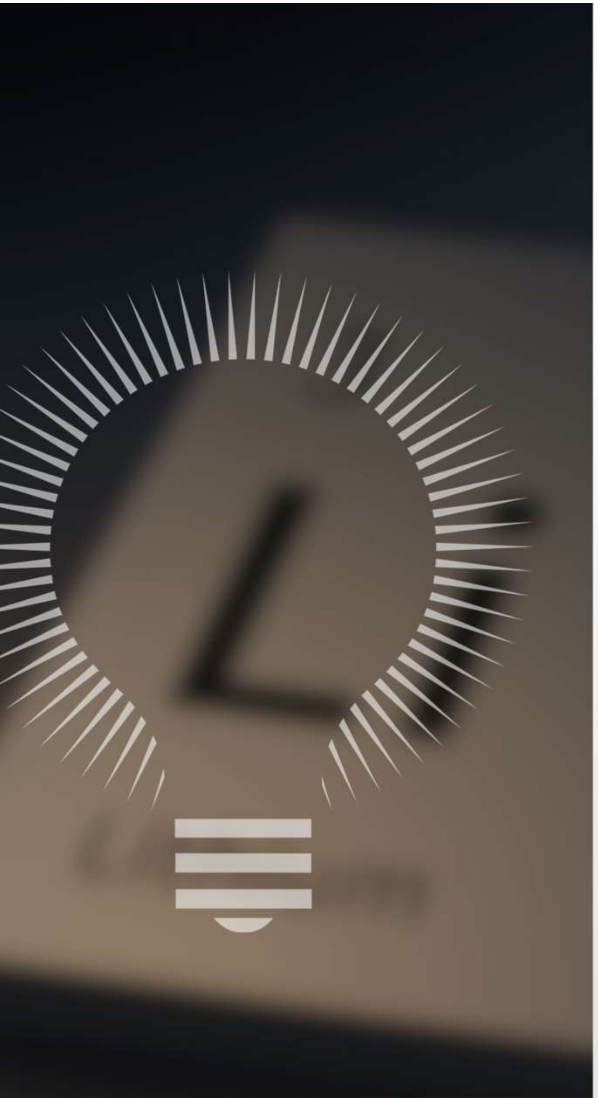
LITHIUM CHLORIDE PRODUCTION

LITHIUM CARBONATE PRODUCTION

REGENERATED ORGANIC
Acid washing solution
Regenerating agent
Conditioning agent

FLOW CHART EKOSOLVE PROCESS





EKOSOLVE consists of several stages

- **Preconditioning** of the Li-rich brines using a proprietary co-extractants, here symbolised as "**Cx**", and acid;
- **Extraction** of the Li from the conditioned natural brines into an organic phase made of Tributyl Phosphate (**TBP**) as the extractant, dissolved and aided by Cx's.

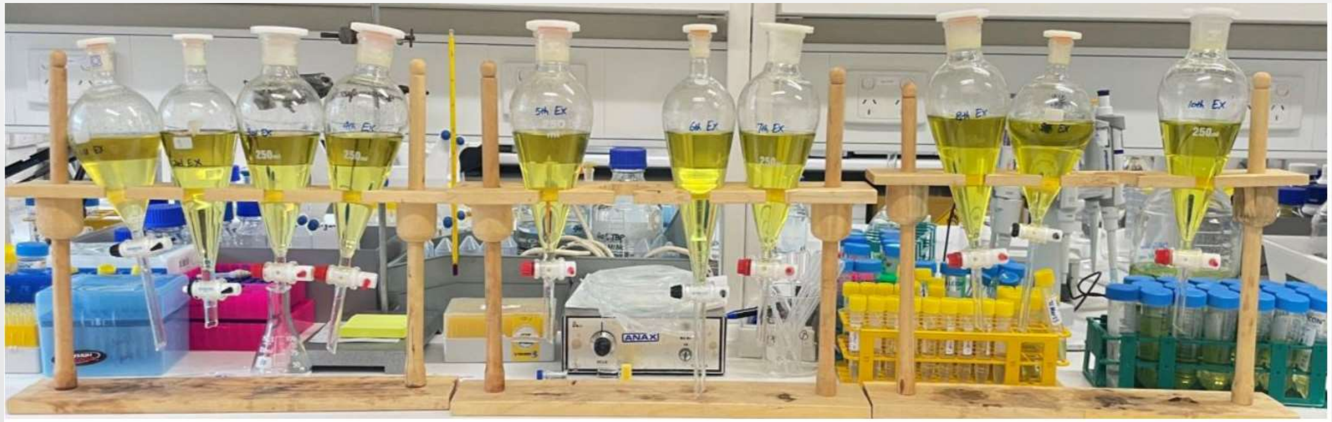
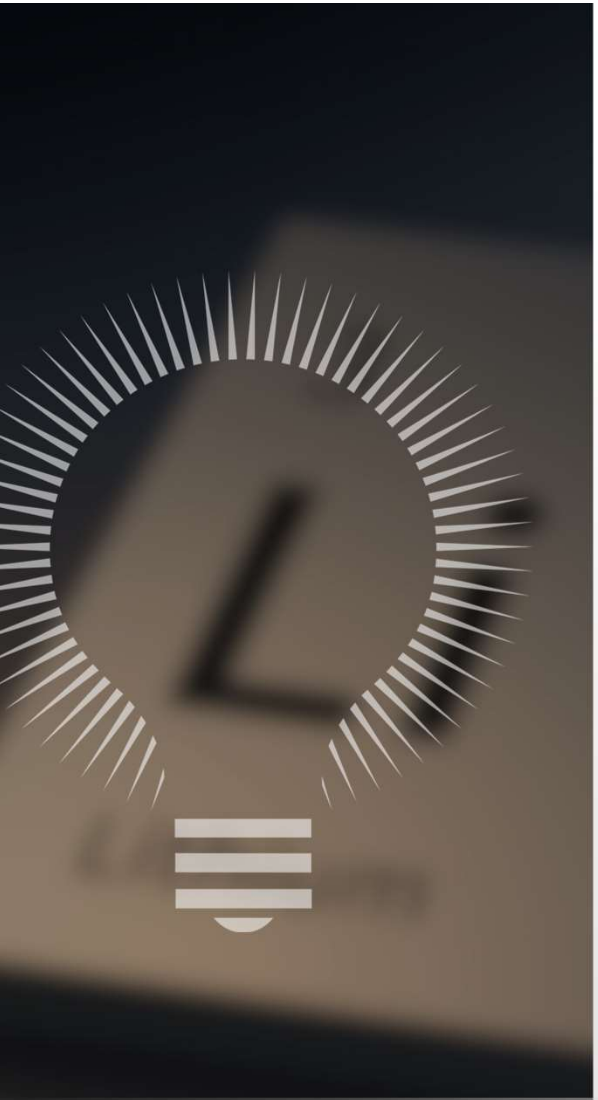


Figure 2 The experimental setup photo (in Separations Lab at the University of Melbourne)



Washing to strip the Mg^{2+} from the loaded organic with a **minimum loss** of Li^{+} using Chlorides as the washing agents obtained from the stripping solution:

Stripping of the organic phase with the help of hydrochloric acid:

Higher HCl concentrations result in higher Li^{+} stripping efficiencies and lower extractant losses.

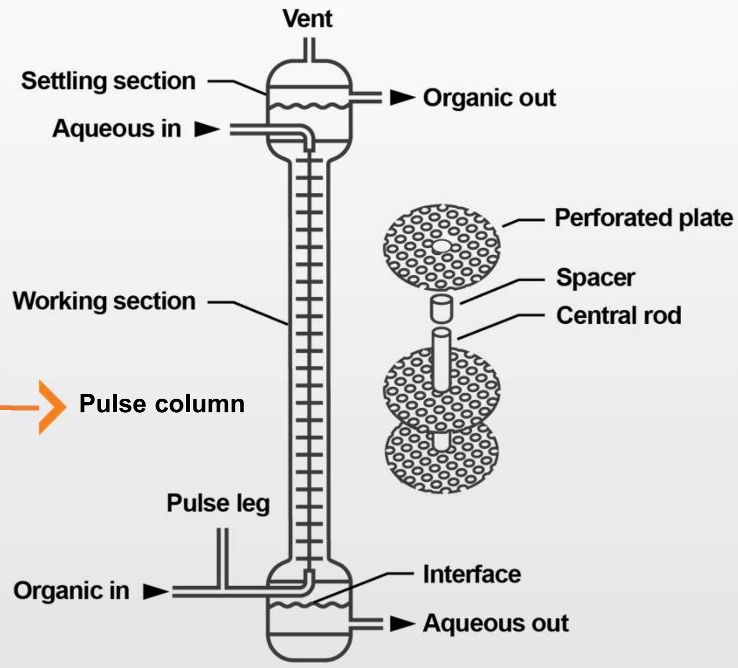
Regeneration of the organic phase and the extractant with

more than 98.5% recovery after each wash

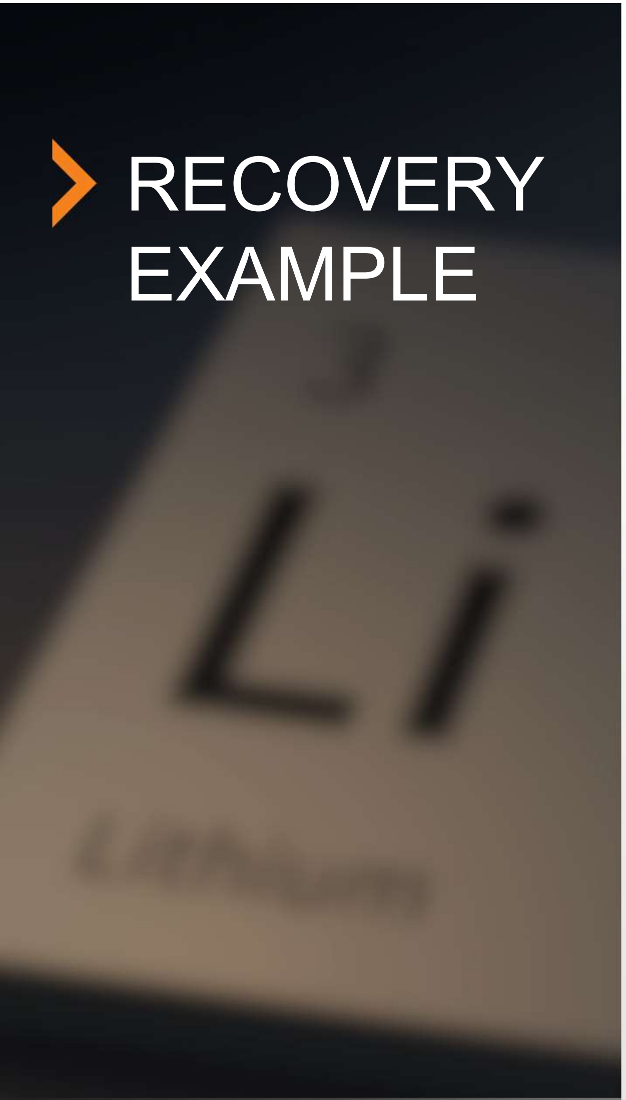
THE EKOSOLVE PROCESS

The EKOSOLVE process occurs in several sequential pulsed extraction columns, each consisting of a large diameter vertical column filled alternatively with disc and doughnut-shaped baffles, which facilitate contact between the immiscible liquids as they pass through the column.

- The aqueous phase enters through a disperser at the top of the column.
- The solvent phase enters through a similar device near the bottom.
- A decanter at each end of the column permits the liquids to coalesce and be poured out separately.
- When the solvent phase is continuous, the interface between the phases is in the lower decanter, and when the aqueous phase is continuous, it is in the upper decanter



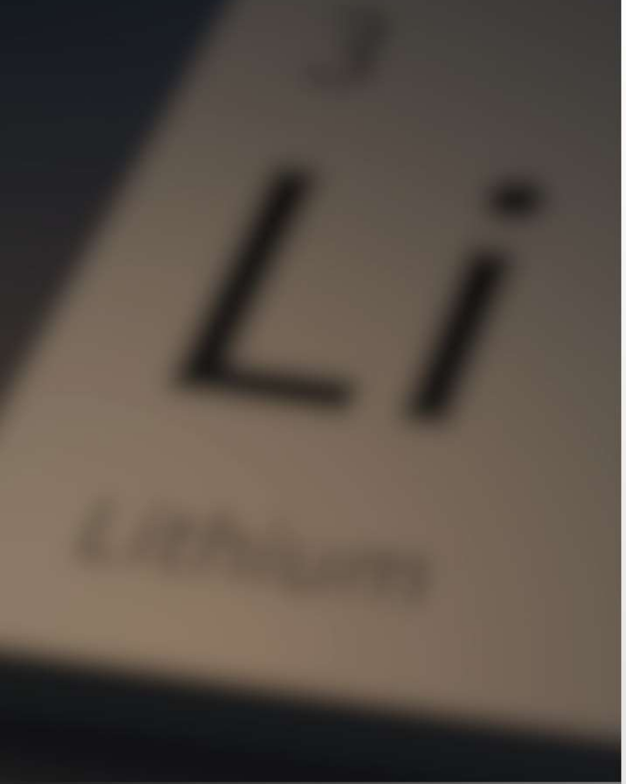
RECOVERY EXAMPLE



An example of the process' recovery, based on **actual tests measurements** performed on natural brines, is summarized below:

Recovered			
	Feed	**Raffinate**	**Recovered Li**
		Li^+ mg/L	
Stage 1	100.0	30.7	69.3
Stage 2	30.7	9.4	21.3
Stage 3	9.4	2.9	6.5
Total recovery			97.1

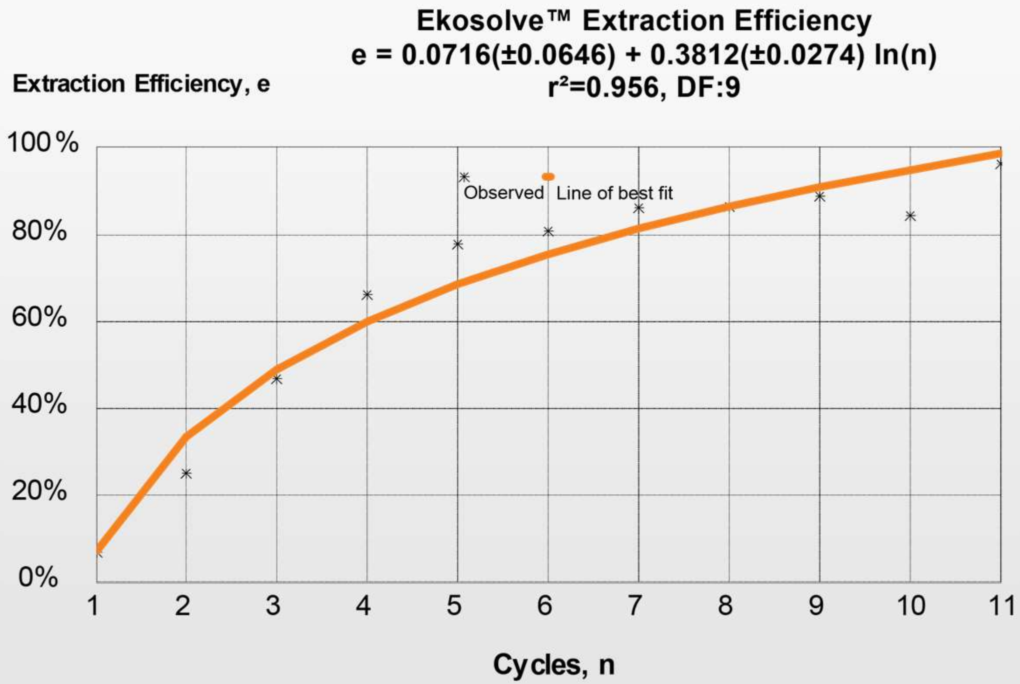
RECOVERY FUNCTION



As the number of stages increases, the lithium recovery approaches asymptotically to 100%.

However, after several stages, the recovery is marginally economic and does not compensate for the costs incurred.

The graph shows the course of this recovery function.



Lithium is recovered as Li2CO3 with a purity exceeding 99% which is battery grade

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ESTIMATES OF CAPITAL AND OPERATING COSTS

Capital and Operating Costs have been appraised as an AACE's Class 2 Estimate, based on detailed unit costs with forced detailed take-off, an estimate with uncertainty ranging from

-15% to +37%

The estimates are based on February 2023 prices for a plant capable of producing 20,000 tonnes per year of Battery Grade Lithium Carbonate.

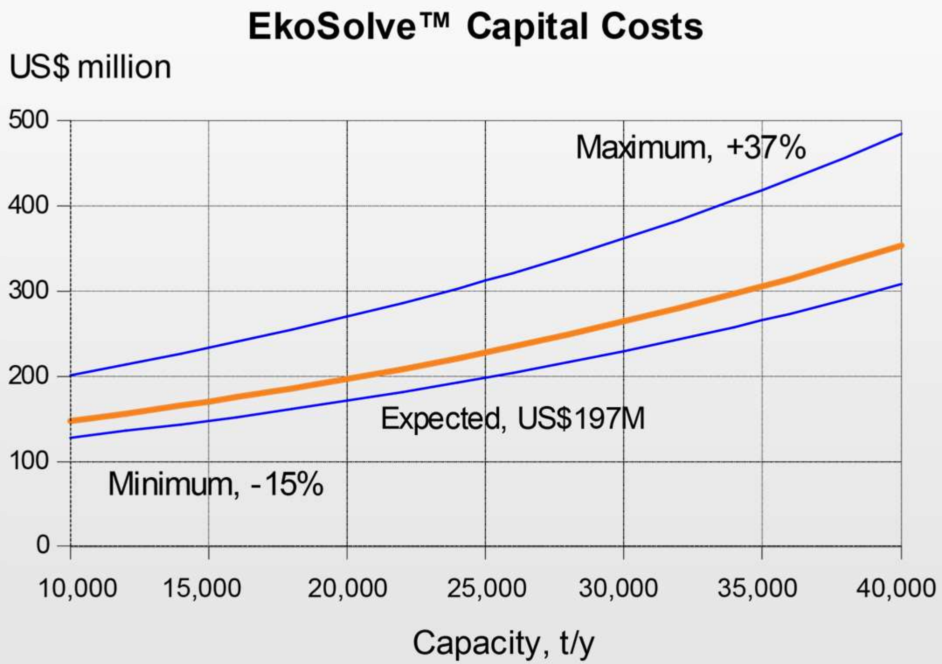
The estimates do not include financial costs, fiscal taxes and royalties and do not account for inflation since 1 Jul 2023.

EKOSOLVE CAPEX

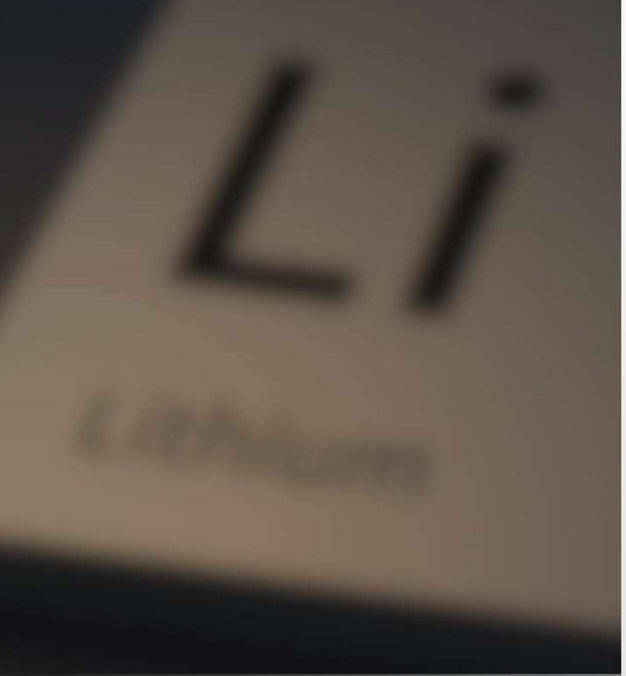
The capital investment required for a plant capable of producing 20,000 Li_2CO_3 per year is expected to be US$197M, ranging from a low of US$171M to a maximum of US$270 million.

This uncertainty arises from the conditions of each project, such as location, ease of access, power availability, reagents' import duties, disposal of waste brines etc.

The figure below shows estimates for several plant capacities.



EKOSOLVE CAPITAL INTENSITY



Capital Costs can be amortised over the annual production to estimate the unit costs per tonne of Li_2CO_3 produced, a Capital Intensity that allows for a comparison of relative capital requirements between **EkoSolve™** and other brine projects.

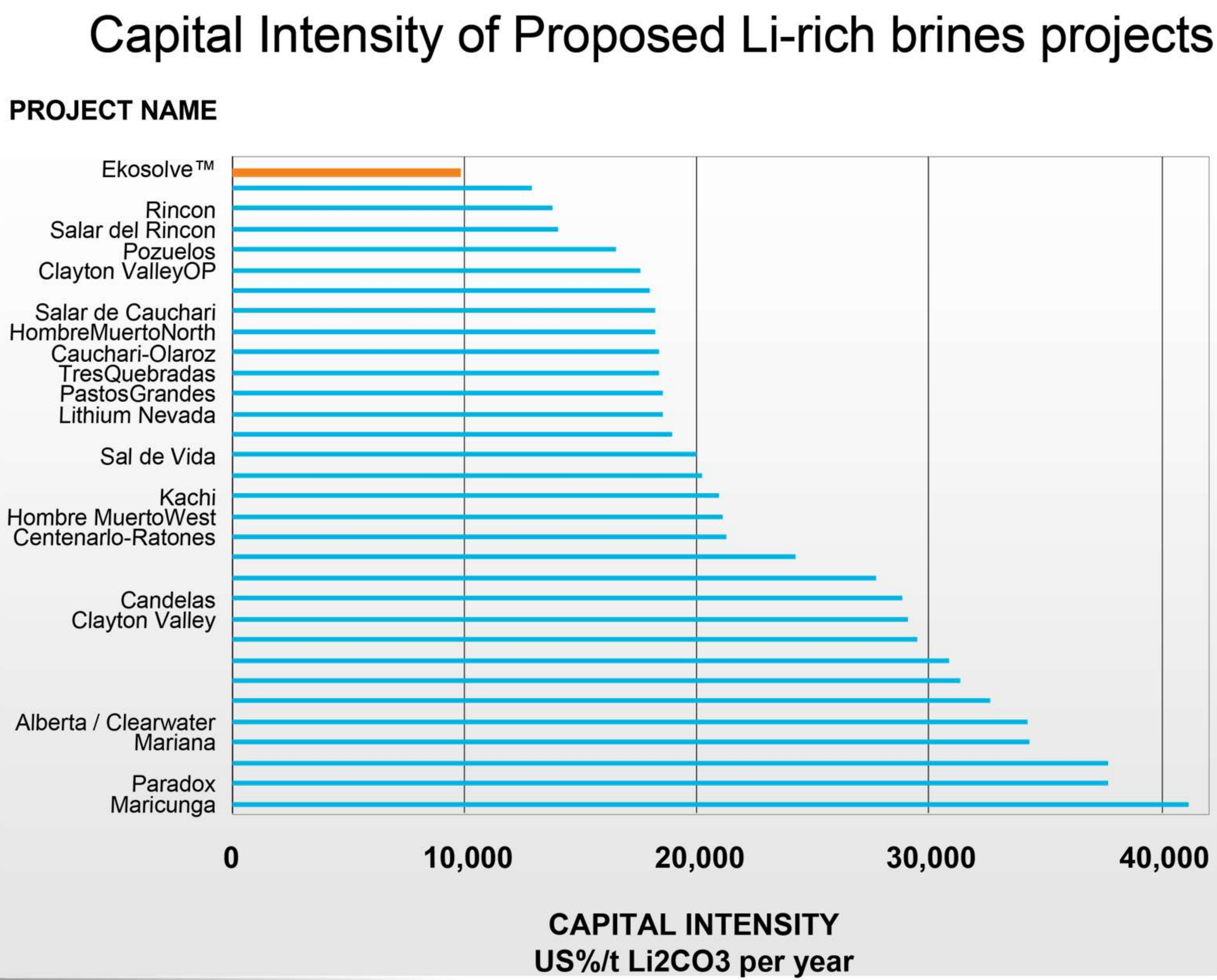
EkoSolve™ Capital Intensity, US$ per tonne of Li_2CO_3 produced annually

	Low	Expected	High
Pulsating extraction column	2,985	3,431	4,701
Initial reagent load	2,902	3,336	4,570
Plant civil installations	746	858	1,175
Generators & power works	580	667	914
Regeneration plant	332	381	522
Caustic HCl electrolytic plant	249	286	392
ECPM	779	896	1,227
Recovered	**8,573**	**9,855**	**13,501**

EKOSOLVE CAPITAL INTENSITY

With a Capital Intensity of US$ 9,855 per metric tone of Li_2CO_3 produced annually, EKOSOLVE compares well with the capital intensity of other proposed brine projects.

Even at its maximum estimated Capital Intensity of US$13,500, EKOSOLVE is still positioned as one of the lowest investments required to develop a Li-rich brine project.



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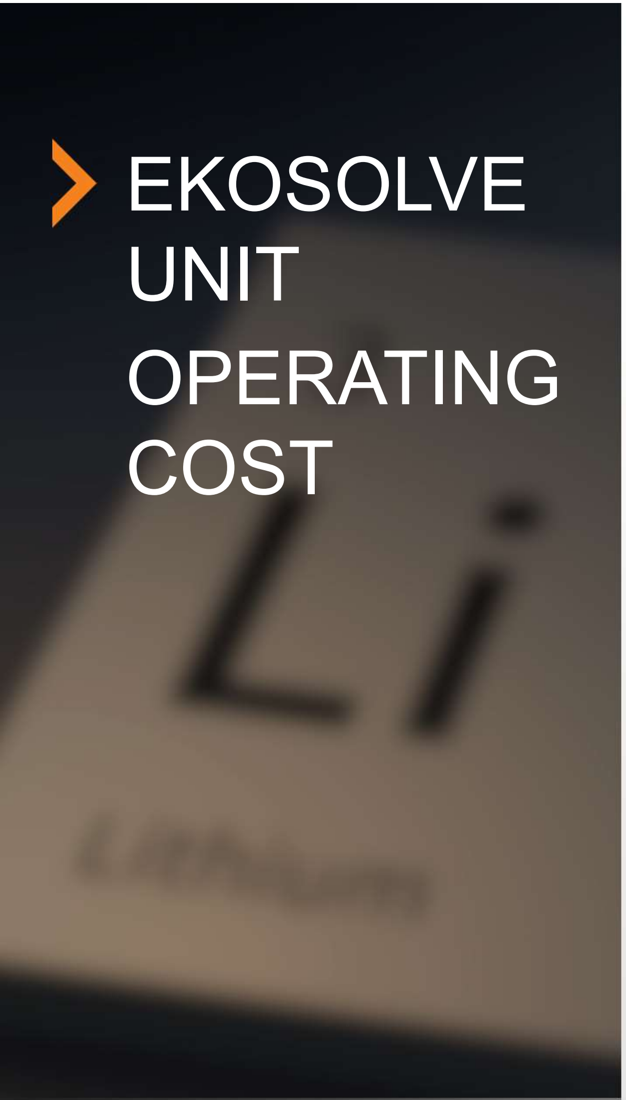

EKOSOLVE UNIT OPERATING COST

The **EkoSolve** operating costs can be estimated at US$2,710 per ton of battery-grade of Lithium Carbonate produced.

The opex has been averaged over ten years; that is to say, it includes commissioning expenses.

This opex does not include the amortisation of the plant capital costs or its maintenance.

Operating costs amortized over 10 years of production, US$/t

	Low	Estimated	High
Reagents	1750	2060	2820
Fuels and Energy	460	540	740
Labour	90	110	150
Operating Costs total	**2300**	**2710**	**3710**

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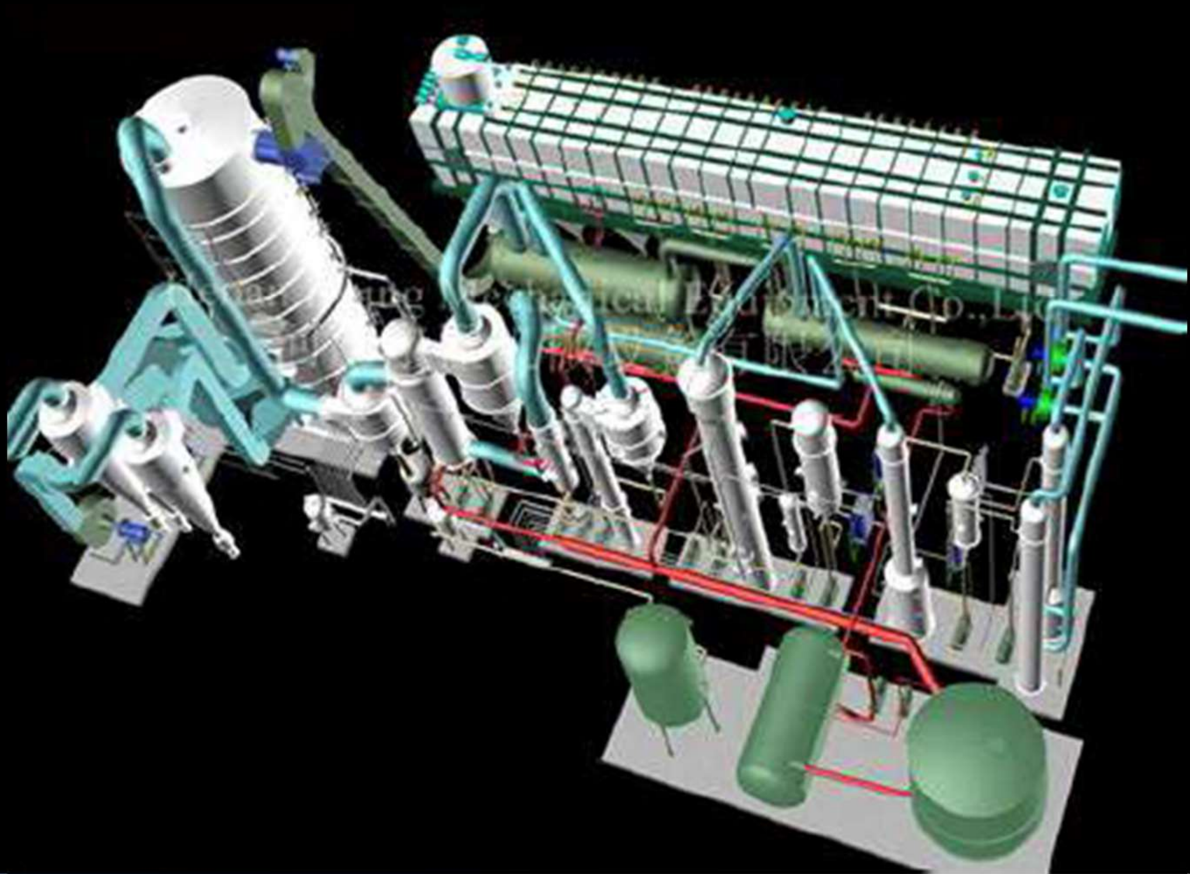
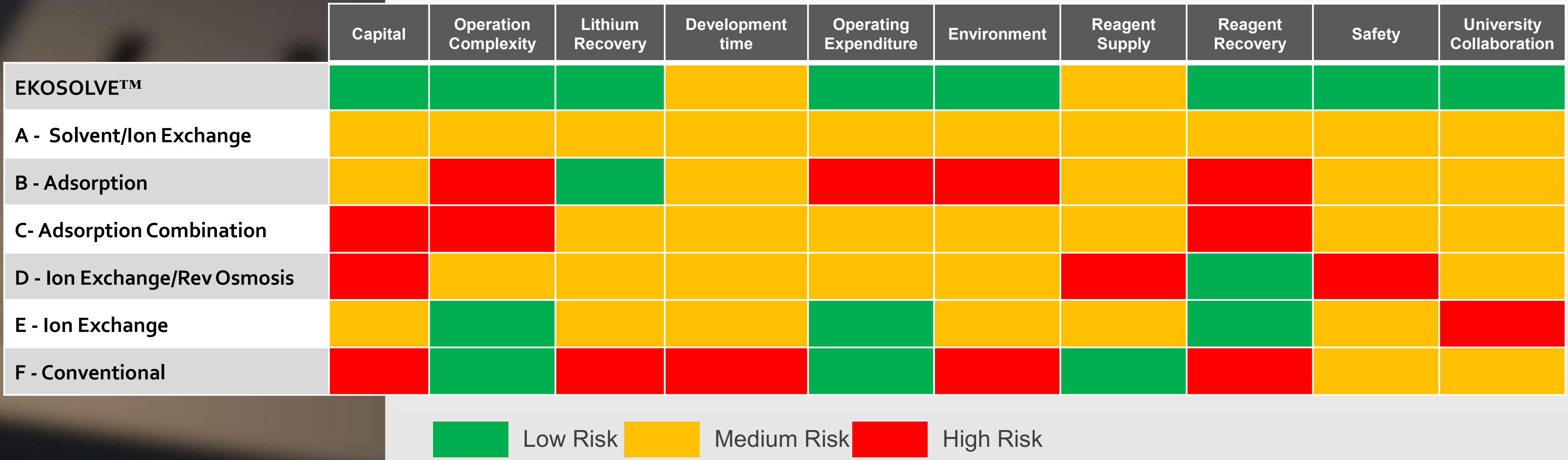
3-D OF A TYPICAL SOLVENT EXTRACTION PLANT



EKOSOLVE TECHNOLGY REVIEW

Various DLE technologies and the risk matrix.



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Thank you

Don’t hesitate to get in touch with us for further information or a proposal to build a plant for your lithium project.

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